

Governing large-scale carbon dioxide removal: are we ready? - an update

Executive Summary

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In 2015, Parties to the United Nations Framework Convention on Climate Change (UNFCCC) agreed to limit global temperature increase to well below 2°C above pre-industrial levels and to pursue efforts to limit the increase to 1.5°C. This goal is to be operationalised in part through achievement of a balance between anthropogenic emissions by sources and removals by sinks, as stated in Article 4 of the UNFCCC's Paris Agreement.

In 2018, the Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5°C (IPCC SR 1.5°C) warned that the impacts of warming at 2°C would be significantly worse than those at 1.5°C. This **IPCC report also found that all pathways to achieve 1.5°C with limited or no overshoot, project the use of Carbon Dioxide Removal (CDR) in the order of 100–1000 GtCO₂ over the 21st century.**

In short, the IPCC SR 1.5°C bolsters the case for pursuing the lower end of the Paris Agreement's temperature goal and makes clear that **it is no longer sufficient to reduce emissions alone — CO₂ will also need to be removed from the atmosphere, on a scale never previously attempted.**

Is the international community prepared for the implementation of CDR options at this unprecedented scale? Can the sustainability challenges, risks and trade-offs inherent in large-scale CDR efforts be managed? What governance tools would need to be in place to deploy CDR options at the levels the IPCC says are needed? Can provisions under the current climate change regime support implementation at scale, or will further provisions and incentives be needed?

This report aims to address these questions, recognising that some degree of reliance on CDR options is now inevitable to achieve the Paris Agreement's long-term temperature goal, as a direct result of the international community's delay in making the necessary transition to a low-carbon economy.

The top-line finding is that **while a number of reporting rules and accounting practices are already in place with direct applicability to the implementation of CDR options, many governance gaps remain.**

The scale of the CDR governance challenge is daunting. The good news, however, is that many of the governance systems needed to support the necessary acceleration in emission reductions under the Paris Agreement will also take us a good way toward filling the gaps needed to govern large-scale CDR. **Addressing large-scale CDR and reducing global emissions cannot be seen as separate activities; they are intimately related, both are needed and their governance goes hand in hand.**

Key insights

1. The scale of CDR needed to limit global warming to 1.5°C depends on the speed of emissions reductions

According to IPCC SR 1.5°C, to avoid or limit any overshoot of the 1.5°C temperature goal, CO₂ emissions will need to be phased out almost entirely by 2050 while the “*balance*” cited in Article 4 would need to be reached by 2070. Current levels of ambition in the Nationally Determined Contributions (NDCs) fall far short of what is needed. The pace of global efforts in the near-term is therefore critical. The longer it takes to reduce emissions, the more large-scale CDR will be needed.

- Substantial amounts of CDR will likely be needed over the remainder of the 21st century even if NDCs are ratcheted up substantially, given insufficient global mitigation action to date.
- If the international community succeeds in ratcheting up NDCs only modestly, an extremely large contribution from CDR will be needed; if NDCs are ratcheted up only marginally, limiting temperature rise to well below 2°C and 1.5°C will be out of reach completely.
- A broad portfolio of CDR options will be required to satisfy the overall need for CDR, to avoid running into limitations inherent in any single CDR option.
- CDR activities and technologies will need to be rolled out sooner rather than later, as delay in deployment and hence capacity to rapidly scale-up a portfolio of options creates substantial future risk.

If Parties to the Paris Agreement bring forward new and updated NDCs by 2020 that are substantially more ambitious in the reductions they deliver for 2030, this can reduce future reliance on CDR to a scale that may be economically feasible and avoid jeopardising sustainable development.

2. A number of existing provisions under the UNFCCC, Kyoto Protocol and Paris Agreement address governance aspects of Carbon Dioxide Removal, but legacy issues remain to be addressed

Provisions under the UNFCCC, Kyoto Protocol and Paris Agreement address the reporting and accounting of CO₂ removals. The IPCC has also provided guidance relevant to Bioenergy with Carbon Capture and Storage (BECCS) and substantial guidance on Carbon Capture and Storage (CCS). The development and application of a new rule set under the Paris Agreement provides a valuable, near-term opportunity to address a number of governance challenges and legacy issues that have not been adequately addressed through existing provisions, or that have arisen due to the scale of CDR that is now required. These include, for example,

- **Presentation of consistent and comparable greenhouse gas (GHG) inventory data** across all Parties, at an appropriate level of granularity in connection with CDR options employed, would help the international community assess the scale of removals underway and track progress toward the necessary “*balance*” between anthropogenic emissions and removals.
- **Consistency in the presentation of NDC information**, and consistency in reporting on progress in NDC implementation and achievement, would help project 2030 emission levels and aid in CDR planning.
- **Adoption of robust land sector accounting rules and robust rules for the use of cooperative approaches under Article 6** would address historic and continuing concerns over environmental integrity in these two contexts.
- **Presentation of separate targets for emission reductions and for removals within NDCs, and the presentation of separate targets for the land sector**, would help ensure that emission reductions take place across all sectors, and avoid a situation in which land sector removals are used to delay a reduction in fossil fuel emissions.

For detailed list see Annex: Table A.

3. Many governance gaps and challenges specific to large-scale CDR will need to be addressed

While existing provisions and guidance under the UNFCCC, Kyoto Protocol and Paris Agreement already cover a number of governance issues related to CDR (as above), many key governance challenges remain. These gaps revolve around 4 key issues:

- The scale and speed of implementation required, and the associated challenges for research and development and for monitoring deployment.
- The substantial incentives that will be needed to scale-up potential CDR options, as sufficient incentives do not at present exist under the UNFCCC or other legal frameworks.
- The trade-offs between, and interactions with, a range of Sustainable Development Goals (SDGs) e.g., food security, water security, that may follow from large-scale implementation intended to achieve climate ends.
- The risks to the climate system and to the SDGs that will follow if CDR options are not implemented at the pace or scale required, if CDR is used inappropriately to compensate for continued fossil fuel emissions, or if large-scale reversals follow large-scale CDR efforts.

The report identifies ten particular governance challenges for the implementation of large-scale CDR:

- **Rapid pace of CDR scale-up required to limit warming to 1.5°C:** many potential CDR options are at a low level of technology readiness, and it may take decades to achieve widespread deployment for these options.
- **Responsibility and ethics of implementation:** to date there has been no clear assignment or acknowledgement of responsibility for development and deployment of CDR options among Parties to the UNFCCC and/or Paris Agreement.
- **Access to information needed to monitor progress:** a significant challenge that will arise once CDR starts to be deployed at scale is how best to monitor progress towards the goal of balancing emissions and removals.
- **Safeguards for sustainable development:** there are constraints on the sustainable potential of BECCS and Afforestation/Reforestation (A/R) due to limits on resource availability.
- **Challenges for measuring, reporting and verifying CO₂ removals:** measurement and verification of the scale of removals from CDR presents substantial governance challenges, in particular in the context of terrestrial sinks.
- **Issues of storage, permanence, leakage and saturation:** a key criterion for successful CDR deployment is that carbon removals be durable. Potential CDR options that store carbon in geological reservoirs and terrestrial reservoirs have different degrees of “*permanence*”.
- **Planning for and monitoring the biophysical effects of deployment:** for land-based CDR options, deployment can have biophysical impacts beyond CO₂ removal that require consideration.
- **Liability and redress:** Safeguards need to be put into place to address physical risks and accounting risks related to reversals of removals and storage.
- **Incentives for CDR deployment:** direct funding and economic incentives will be needed for the deployment of CDR at the pace and scale required to achieve the Paris Agreement’s long-term temperature goal.
- **Public awareness and acceptance:** public awareness and acceptance of CDR will be important for its development and roll-out. At the broadest level, public acceptance of CDR as a concept is influenced by the ethics of pursuing CDR and the perceived risk of moral hazard.

4. Priority gaps on mitigation, information, accounting, knowledge and incentives can be addressed in the near-term, both inside and outside of the UNFCCC process

Certain governance priorities can be addressed in the near-term. These include the following interventions to address gaps in mitigation, information, accounting, knowledge, and incentives:

- Narrow the mitigation gap to reduce possible future reliance on CDR options.
- Improve inventory data and information management systems.
- Put in place robust accounting rules.
- Create incentives to accelerate research, investment and implementation.
- Engage the research community in scoping specific CDR options and necessary incentives.
- Improve public awareness of potential CDR options, risks and trade-offs in planning processes.
- Improve international collaboration and cooperation.

Some of these gaps can be addressed through the ongoing negotiating processes under the Paris Agreement, while others will require decisions and interventions outside the UNFCCC process.

For more detail see Annex: Table B.

Annex

Table A: Existing provisions

UNFCCC, Kyoto Protocol and Paris Agreement contexts		Selected provisions*	Key points
Existing provisions from which lessons can be learned	UNFCCC	<ul style="list-style-type: none"> Annex I Reporting Guidelines (Decision 24/CP.19) Non Annex I Reporting Guidelines (Decision 17/CP.8) Biennial reporting and review guidelines for developed and developing countries (Decision 2/CP.17) REDD+ (Decisions 1/CP.16, 2/CP.17, 12/CP.17, 9/CP.19, 10/CP.19, 11/CP.19, 12/CP.19) 	Gaps and differences between UNFCCC and Kyoto Protocol provisions form a starting point for the Paris Agreement rule-book and highlight the need to move towards consistent and comparable GHG inventories and robust accounting rules for all Parties
	Kyoto Protocol	<ul style="list-style-type: none"> Land use, land use change and forestry (Decisions 16/CMP.1, 17/CMP.1, 18/CMP.1) Afforestation and reforestation under CDM and sink enhancement under JI (Decisions 5/CMP.1, 9/CMP.1, 13/CMP.1, 15/CMP.1) CCS as CDM project activities (Decisions 10/CMP.7, 5/CMP.8) The Cancun Agreements: Land use, land use change and forestry (Decision 2/CMP.6) Second commitment period (Decisions 2/CMP.7, 1/CMP.8, 2/CMP.8, 5/CMP.8) 	
Paris Agreement provisions to be built upon	Land sector	<ul style="list-style-type: none"> Decision 1/CP.21 Articles 4, 5, 13, 14 Decision 4/CMA.1 Decision 18/CMA.1 	Robust reporting and accounting guidance for NDCs needed as part of an effective CDR governance architecture. This includes robust accounting rule for Article 6 transfers, land sector accounting rules and an effective Global Stocktake.
	Assessment of progress toward temperature goal / balance between emissions and removals	<ul style="list-style-type: none"> Decision 1/CP.21 Articles 2, 4, 13, 14 Global Stocktake (Decision 19/CMA.1) Transparency Framework (Decision 18/CMA.1) Further Guidance in relation to the mitigation section of decision 1/CP.21 (Decision 4/CMA.1) 	
	Transfers between Parties	<ul style="list-style-type: none"> Decision 1/CP.21 Articles 4, 6, 13 	Robust accounting rules needed for Article 6 market-based transfers to avoid double counting, ensure environmental integrity and ensure transparency, including in governance.

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Existing IPCC guidelines to be built upon	IPCC Guidelines relevant to A/R, CCS and BECCS	<ul style="list-style-type: none"> • Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories • IPCC Special Report on Land Use, Land-use Change and Forestry, 2000 • Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000 • IPCC Good Practice Guidance for Land Use, Land-use Change and Forestry, 2003 • IPCC Special Report on Carbon Capture and Storage, 2005 • 2006 IPCC Guidelines for National Greenhouse Gas Inventories • 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands • 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories • IPCC The Special Report on Climate Change and Land, 2019 	Additional guidance is needed for reporting lifecycle emissions and removals from bioenergy (with and without CCS) and Direct Air Capture with Carbon Storage (DACCS).
* This listing is not intended to be inclusive, but rather to point to key decisions, provisions and documents.			

Table B: Key governance challenges and gaps that can be addressed in the near-term:

Governance challenges and gaps	Entity or entities	Options for addressing them
1. Narrow the mitigation gap to reduce possible future reliance on CDR options	UN Secretary General	<ul style="list-style-type: none"> • Maintain momentum from the IPCC SR 1.5°C by raising awareness of climate impacts and risks at low levels of temperature change • Encourage new and updated NDCs in this 5-year cycle, with far more ambitious emission reduction targets for 2025 and 2030
	UNFCCC Executive Secretary	<ul style="list-style-type: none"> • Encourage communication of 2050 strategies, consistent with 1.5°C pathways • Encourage shift to economy-wide NDCs • Facilitate greater collaboration between treaty Secretariats • Encourage distinct land sector targets • Encourage targets for negative emissions
	Parties	<ul style="list-style-type: none"> • Enhance 2030 NDC ambition, to avoid extreme reliance on CDR options • Communicate 2050 Low Emission Strategies (LT-LEDS) including consideration of targets for negative emissions, options and needs • Evolve a common understanding of "net zero" (all sectors, all gases, no reliance on international units)

2. Improve inventory data and information management systems	IPCC	<ul style="list-style-type: none"> • Develop IPCC Guidance on biomass energy lifecycle emissions for inclusion in national emissions inventories • Develop IPCC Guidance on emission inventory and reporting for DACCS
	IGOs, NGOs, CSOs	<ul style="list-style-type: none"> • Explore how external datasets can be used to verify sectoral emissions data (e.g. through atmospheric measurements) • Support capacity building initiatives
	Parties	<ul style="list-style-type: none"> • Provide information necessary for clarity, transparency and understanding of existing NDCs in Decision 4/CMA.1 for first and subsequent NDCs • Shift to economy-wide NDCs • Apply common accounting rules in Decision 4/CMA.1 for first and subsequent NDCs • Present distinct land sector targets • Present negative emission targets • Adopt common GHG reporting formats that facilitate aggregation
3. Put in place robust accounting rules	Parties	<ul style="list-style-type: none"> • Move toward common accounting rules for the land sector (e.g. for Harvested Wood Products, Natural Disturbances) • Develop robust rules for Article 6 transfers under Article 6.2 and 6.4
	UNFCCC Executive Secretary	<ul style="list-style-type: none"> • Collaborate with International Maritime Organization (IMO), International Civil Aviation Organization (ICAO), Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and Montreal Protocol to enable sharing of emissions data, to ensure no double counting of emission reductions and ensure work is not at cross-purposes
	IPCC	<ul style="list-style-type: none"> • Develop guidance on accounting for life cycle emissions involving multiple sectors and multiple countries
4. Create incentives to accelerate research, investment and implementation	Research community	<ul style="list-style-type: none"> • Develop policy packages to support accelerated deployment • Identify inexpensive no-regrets options for immediate implementation • Consider ways to share risks and responsibilities for research and development of less mature options (e.g. public / private partnerships, particularly where existing infrastructure and plans can be utilised)
	Parties	<ul style="list-style-type: none"> • Develop policy packages to support accelerated deployment • Provide direct financial and capacity building support for low cost no-regrets CDR options with known co-benefits (A/R, soil sequestration, ecosystem restoration) • Reserve market based cooperative approaches under Article 6.2 and 6.4 for reductions that are clearly permanent, additional and readily measurable and verifiable • Consider ways to share risks and responsibilities for research and development of less mature options (e.g. public / private partnerships, particularly where existing infrastructure and plans can be utilised) • Provide direct financial support for expensive CDR options

<p>5. Engage the research community in scoping specific CDR options and necessary incentives</p>	<p>Research community</p>	<ul style="list-style-type: none"> • Build scenarios around specific CDR options, value chains and their sustainability implications (e.g., BECCS linked to existing and new CCS sites, DACCS linked to renewable energy, other land-based options with sustainability benefits) • Research environmental aspects of CDR options and portfolios, including storage permanence and leakage • Support regional, bottom up studies to identify realistic, sustainable removal potential in given locations • Identify pathways for collaboration, cost-sharing and benefit sharing, as well as options for the allocation of responsibilities and liability
<p>6. Improve public awareness of potential CDR options, risks and trade-offs in planning processes</p>	<p>IGOs, NGOs, CSOs</p>	<ul style="list-style-type: none"> • Increase public awareness of co-benefits • Engage a wide range of stakeholders in planning processes • Identify areas or facilities with potential to accommodate large-scale CDR options • Establish a registry of CDR initiatives and projects, including information on scale and location • Provide information from external datasets to facilitate tracking of CDR deployment, e.g. on forest cover, clearing, natural disturbances, from satellite data
<p>7. Improve international collaboration and cooperation</p>	<p>ICAO and IMO</p>	<ul style="list-style-type: none"> • Data sharing and enhanced collaboration with UNFCCC • Develop long-term vision for zero emissions in their sectors
	<p>IPCC</p>	<ul style="list-style-type: none"> • Evaluate the implications of geophysical feedbacks and other issues for emission pathways and CDR needs consistent the Paris agreement long-term temperature goal, for inclusion in assessment reports that will inform the Global Stocktake
	<p>Research community</p>	<ul style="list-style-type: none"> • Emissions-reduction tracking initiatives: expand tracking of NDCs and current policies to include CDR deployment

The full version of the report can be downloaded from: <https://bit.ly/CDRReport2021>